Univerza v Mariboru
University of Maribor

Fakulteta za naravoslovje in matematiko / Faculty of Natural Sciences and Mathematics

OPIS PREDMETA / SUBJECT SPECIFICATION	
Predmet:	**Izbrana poglavja iz modeliranja sistemov v okolju**
Subject Title:	**Selected Topics in Modelling of Environmental Systems**

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Doktorski študij Ekološke znanosti / Doctoral Study Ecological Sciences		Izbirni 1 ali 2 ali 3	**2 ali 3 ali 4 ali 5**

Univerzitetna koda predmeta / **University subject code:**

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Lab. work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
5			5		140	**5**

Nosilec predmeta / **Lecturer:** Marko MARHL

Jeziki / **Languages:**	**Predavanja** / **Lecture:**	slovenski / Slovenian
	Vaje / **Tutorial:**	slovenski / Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Poznavanje fizike, matematike in računalništva na ravni douniverzitetnega programa	Knowledge of physics, mathematics and computer sciences at undergraduate level

Vsebina:	**Contents (Syllabus outline):**
Obravnavana so izbrana poglavja iz naslednjih sklopov.	Selected topics in the following chapters are discussed.

Vsebina:

Obravnavana so izbrana poglavja iz naslednjih sklopov.

- Okoljski sistemi: struktura, dinamika in razvoj sistemov
- Analiza sistemov
- Kvalitativna analiza sistemov
  - Določitev sistema in njegove okolice, ki pomembno vpliva na dinamiko sistema. Razgradnja sistema; prepoznavanje komponent sistema, določitev povezav med deli sistema, medsebojnih vplivov in zunanjih vplivov na sistem.
  - Kvantitativna analiza dinamike sistemov Določanje spremenljivk v sistemu, ki opisujejo stanja in tokove. Medsebojni vplivi in zunanji vplivi na posamezne spremenljivke.
- Opis dinamike sistemov
  - Kvalitativni opis dinamike sistemov: diagrami stanj in tokov, kavzalni diagrami.
  - Kvantitativni opis sistemske dinamike: prehod s kavzalnih diagramov in diagramov stanj in tokov na matematičen opis vpliva tokov količin na njihovo dinamiko; diferenčne enačbe; matematični model.
- Modeliranje, simulacija, napovedi modelov
- Konstruiranje preprostih modelov: populacijski modeli, modeli ekosistemov, kroženje snovi v naravi, modeli na celični ravni, … Reševanje diferenčnih enačb v urejevalnikih tabel (Excel) –

Contents (Syllabus outline):

Selected topics in the following chapters are discussed.

- Environmental systems: structure, dynamics and system's development
- Systems analysis
- Qualitative system analysis:
  - Determination of a system and its surrounding that considerably influences the systems dynamics. Decomposition of a system into components, determining the interrelations between the components, influences between the components and external influences on the system.
  - Quantitative analysis of system dynamics: Determination of system variables – the so-called stock and flow variables. Interrelated influences and external influences on the variables.
- Description of system dynamics
  - Qualitative approaches in system dynamics: causal-loop diagrams, stock-flow diagrams.
  - Quantitative approaches in system dynamics: quantification of causal-loop diagrams and stock-flow diagrams; mathematical description of influences of fluxes on system variables; mathematical model.
- Modelling, simulation, model prediction
- Construction of simple models: models of population dynamics, ecosystems, models on cellular level, …. Solving of equations in spread-

simulacija s poudarkom na napovedni moči modelov.	sheet programmes (Excel) – simulations with emphasis on predictive power of models.
• Uporaba računalniških programov	• Using computer programs
• Grafično orientirani računalniški programi za modeliranje sistemske dinamike: DynaSys, Stella, Vensim, Powersim, Madonna, ….	• Graphic-oriented computer programmes for modelling of system dynamics: DynaSys, Stella, Vensim, Powersim, Madonna, ….

Temeljni študijski viri / Textbooks:

- Ford, A., 1999: Modeling the Environment; An Introduction to System Dynamics Modeling of Environmental Systems, Island Press.
- Hritonenko, N., Y. Yatsenko, 1999: Mathematical Modeling in Economics, Ecology and the Environment, Springer, New York.
- Jørgensen, S. E., B. Halling-Sørensen, S.N. Nielsen, 1996: Handbook of Environmental and Ecological Modeling, CRC PressLLC.
- Ossimitz, G., 2000: Entwicklung systemischen Denkens, Theoretische Konzepte und empirische Untersuchungen, Profil Verlag, München.
- Strokovni in znanstveni članki v revijah / Articles published in professional and scientific journals.

Cilji:	**Objectives:**
• Podrobno ponazoriti zvezo med strukturo, dinamiko in razvojem okoljskih sistemov	• Presenting the relationship between the structure, dynamics, and development of environmental systems in detail
• Podrobno predstaviti odnos med sistemskim mišljenjem in modeliranjem sistemske dinamike	• Establishing the relationship between the system thinking and system dynamics modelling in detail
• Opraviti podrobno celovito kvalitativno in kvantitativno analizo dinamike okoljskih sistemov	• Carrying out a advanced complete qualitative and quantitative analysis of system dynamics
• Prenos uporabe univerzalnih metod analize na druga področja	• Transfer of using general methods of the analysis to other fields

Predvideni študijski rezultati: **Intended learning outcomes:**

Znanje in razumevanje:	Knowledge and Understanding:
• Poznati zvezo med strukturo, dinamiko in razvojem okoljskih sistemov v podrobnostih	• Know the relationship between the structure, dynamics, and development of environmental systems in detail
• Podrobno poznati odnos med sistemskim mišljenjem in modeliranjem sistemske dinamike	• Know in detail the relationship between the system thinking and system dynamics modelling
• Podrobno obvladati kvalitativno in kvantitativno analizo dinamike okoljskih sistemov na enostavnih primerih	• Be able to carry out a complete qualitative and quantitative analysis of system dynamics for simple systems in detail
• Znati podrobno uporabljati grafično orientirane računalniške programe za modeliranje in simulacijo dinamike sistemov	• Be able to use graphic-oriented computer programmes for modelling and simulation of dynamical systems in detail
Prenesljive/ključne spretnosti in drugi atributi:	Transferable/Key Skills and other attributes:
• Metode kvalitativne in kvantitativne analize dinamike sistemov so univerzalne in jih je mogoče uporabiti na najrazličnejših področjih	• Methods for qualitative and quantitative analysis of system dynamics are universal and can be implemented in different fields of research
• Poudarek je na prenosu podrobnega znanja na druge sisteme ter povezavi predvsem okoljskih in bioloških sistemov	• In particular, a advanced knowledge transfer is emphasised to other fields and finding interconnections between environmental and biological systems

Metode poučevanja in učenja: **Learning and teaching methods:**

• Predavanja	• Lectures
• Teoretične vaje	• Theoretical exercises
• Vaje na računalniku	• Computer exercises
• Eksperimentalne vaje	• Experiments

Načini ocenjevanja: Delež (v %) /   **Assessment:**

	Weight (in %)	
• Seminarska naloga • Pisni kolkvij • Ustni izpit	30 % 30 % 40 %	• Seminar essay • Written partial exam • Oral exam

Materialni pogoji za izvedbo predmeta :	*Material conditions for subject realization*
• *Multimedijska predavalnica* • *Učilnica z računalniki za študente*	• *Lecture hall for multimedia presentations* • *Laboratory with computers for students*

Obveznosti študentov:	*Students' commitments:*
(pisni, ustni izpit, naloge, projekti)	*(written, oral examination, coursework, projects):*
• Seminarska naloga • Pisni kolkvij • Ustni izpit	• Seminar essay • Written partial exam • Oral exam